Review of the West Coast Fisheries Input-Output Model

Submitted to the Council of Independent Experts (CIE), on behalf of the National Marine Fisheries Service (National Oceanic and Atmospheric Administration)

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Executive Summary

This report provides findings of an independent professional review of the Input-Output Model for Pacific Fisheries (IO-PAC) developed by economists at the National Marine Fisheries Service, Northwest Fisheries Science Center (NMFS-NWFSC). Documents were reviewed that described the regional model and surveys that were conducted to estimate fishing vessel expenditure patterns. A meeting to discuss the background for economic modeling of the fishery sector, and construction and application of the regional economic model was held at the NWFSC headquarters in Seattle on October 6, 2009, with NWFSC staff and two independent reviewers present, along with other fisheries experts.

The regional economic model developed by NWFSC was designed to estimate economic impacts of changes in fisheries harvests on the commercial fishing industry, and the distribution chain of wholesale seafood dealers and seafood processors. The model largely follows the approach taken with a similar model developed for the Northeast U.S fisheries by Steinback and Thunberg (2006), although with important exceptions. The model uses the *IMPLAN Professional* software system and associated state and county data sets for construction of regional input-output models with social accounting matrices (IO-SAM), built for individual port areas consisting of one or more counties, or for individual states or the entire region of west coast states (Washington, Oregon, California). The models were extensively modified to incorporate new industry sectors for 19 different types of fishing vessels classified according to the typology of the Pacific Fisheries Commission, and new commodities for 32 species/gear type combinations. Production functions were developed for the vessel types based on cost-earnings surveys of the limited-entry and open access fishing fleets, together with independent information on moorage fees and state-specific taxes. Survey data were deemed sufficient to develop unique production functions for eight of the vessel types; however, little or no data were available for 11 other vessel types, which required that a generic weighted average production function be used. It is intended that new information for specific types of vessels will become incorporated into the model as it becomes available through future surveys that are to be done on a 3-year cycle. Changes in revenues for specific vessel types or species/gear commodity types were estimated from landings data available from Pacific Fisheries Information Network (PACFIN). The modeling used an accepted technique of setting regional purchase coefficients (RPCs) to zero in order to avoid double-counting of backward-linked effects, and to enable use of output (revenue) changes as inputs to the model rather than final demand, as is generally the case for input-output models.

In general, it was found that the regional modeling approach followed by the NWFSC represents the state of the art and best professional practice in regional economic impact analysis. The model and supporting data are strongest for analysis of impacts of changes in groundfish harvests. The model was well documented, such that its technical merit could be fully appraised.

Certainly, there are improvements that could be made to the model, including use of better data on capital costs for vessels, product flows seafood dealers and processors, and markup margins by these market channels. A shortcoming of the production functions was the lack of information on capital costs for vessel ownership, which

may be a significant cost. This could be reasonably estimated with existing survey data reported on vessel market values, together with expert opinion on average useful life or turnover times. The classification of vessel types available from the Pacific Fisheries Commission is well known but appears to not be very robust. Perhaps a more rigorous classification of vessels could be accomplished by cluster analysis of the PACFIN landings data, to identify a somewhat smaller but mutually exclusive set of vessel types that reflect common patterns of fishing activity. Better data is needed to estimate product flows from the harvesting sector to wholesale seafood dealers and processors. The markup margin for seafood dealers should be adjusted downward, consistent with information from the Economic Census.

There were some concerns expressed about the staff time and effort required to run this modeling system for impacts that may affect a number of individual port areas. The new version 3 of the IMPLAN software, to be released this year, will offer a multiregional modeling capability, which may allow more efficient handling of such impact analyses. It may be desirable to develop models that consolidate Alaska fisheries with those for the west coast of the coterminous U.S., since many vessels operate in both areas.

It is recommended that the model be updated at least every three years with new IMPLAN data to reflect changes in the regional economy, as well as new information from fishing fleet surveys. It is recommended to incorporate recreational fisheries into the model, as practicable, and to extend the model as a Computable General Equilibrium (CGE) model, in order to account for changes in market prices and capacity constraints.

Background

The commercial marine fisheries sector on the west coast of the coterminous United States (Washington, Oregon and California) is a major contributor to the economy of the region, with landings in 2006 valued at $434 million. The fishery has over 90 species commercially harvested, including groundfish species such as Hake, Sablefish Dover Sole, Thornyheads, Lingcod and numerous Rockfish species, as well as Salmon, Tuna, Halibut, Shrimp and Crab. Hake (Whiting) is the largest commercial species group, with annual harvests of around 200,000 metric tonnes, representing 44% of total revenue, followed by Sablefish (28%). Commercial fishing activity is year-round for groundfish species, but may be highly seasonal for others, and most fishing vessels target different species or use different gears at different times depending upon availability. A variety of fishing gear is used, including bottom trawls and dredges, mid-water trawls, fixed gear for hook and line trolling, nets, and pots/traps. There are about 264 vessels in the limited-entry fishing fleet, and 1152 vessels that participated in open-access fisheries in 2005-06. Recreational fishing also impacts the resource, especially for species in near shore waters.

A number of commercial fish species have been declared overfished on the west coast of the U.S, resulting in management actions to reduce catch and rebuild the fishery. Management actions include trip limits, license limitations, area closures, restrictions on certain gear types used, and buyback programs for vessels or permits. Some seven species of rockfish have been declared overfished since 1999. Previously, Lingcod and Hake were overfished, but these stocks have been successfully restored. In some cases (e.g. Rockfish), regulatory actions have reduced catches by 80 percent. An individual tradable quota (ITQ) system is being studied as a market-based system for fishery regulation, and is expected to reduce the capacity of the fleet by at least 50 percent.

The Magnuson-Stevens Act of Congress (2007) mandates that NMFS consider economic impacts on fishing-dependent communities for all proposed fisheries recovery actions. In the past, the agency has relied upon the Fisheries Economic Assessment Model (FEAM) developed by private sector economists for these assessments on the West and South Atlantic coasts. Although this model is well accepted by stakeholders, it is not well documented, making it difficult to evaluate its technical merit. The application of regional economic models to evaluate economic impacts of fisheries regulations has sometimes been contentious, with opposing viewpoints represented by the fishing industry and environmental organizations, who respectively advocate for weaker and stronger restrictions. In fact, the NMFS is currently under litigation concerning such matters.

This situation has motivated the agency to develop its own economic models that can be customized and used by NWFSC staff. A model was developed for commercial fisheries in the northeast region of the U.S. from Maine to North Carolina (NERIOM) by the NMFS-Northeast Fisheries Science Center (Steinback and Thunberg, 2006). It appears that this model has been well accepted by stakeholders in this region, and has withstood scrutiny under legal challenges.

Reviewer's Role in the Review Process

This reviewer participated in the review process as an outside independent expert on input-output analysis and regional economic impact analysis, through a consulting arrangement with Northern Taiga Ventures, Inc (NTVI) which seeks to provide independent individual technical reviews for fisheries science and management, subject to strict rules for conflict of interest. The specific provisions of this contract are shown in Appendix 3 (Statement of Work for External Independent Peer Review by the Center for Independent Experts, for Review of Methods Used to Produce the West Coast Region Fishery Input-Output Model). Copies of documents were received in advance of the review meeting describing the IO-PAC model and supporting surveys, along with documentation of a similar model for the northeast U.S. region, as shown in Appendix 1.

The review meeting was held on October 6, 2009, at NWFSC headquarters in Seattle. In addition to myself, present were another independent reviewer from within the agency (Steinback, NMFS-NEFSC), the regional model co-investigator (Phil Watson, University of Idaho), NMFS staff (Hastie, Lee, Lian, Leonard, Anderson, Plummer, Freese, Seung), and representatives of the Pacific States Marine Fisheries Commission (Colpo) and Pacific Fisheries Management Council (Waters), as shown in Appendix 2. A third independent reviewer was engaged to provide a desktop review of the model, but did not participate in the meeting (Kirkley). It should be noted that Steinback is a recognized authority on regional economic impact assessment for fisheries, and was co-principal investigator for developing a comprehensive and rigorous model for fisheries in the northeast U.S. (Steinback and Thunberg, 2006).

Summary of Findings

Findings of the review are discussed as follows, for each item in the Terms of Reference (ToR) specified in the Scope of Work.

Modeling Approach and Methodology

The IO-PAC model is based upon the well-established technique of input-output analysis, also known as interindustry analysis (Leontief, 1953), which attempts to represent the structure of a regional economy in terms of linkages between industry sectors and final demand (consumers, exports), such that changes in demand for any sector will cause predictable changes in other sectors and in the overall economic activity. Extended versions of IO models which incorporate resident households, government sectors, capital investment and inventory accounts endogenously within the model are known as Social Accounting Matrices (SAM) (Miller and Blair, 1985). The documentation for the IO-PAC model gives a good, concise summary of the background of IO-SAM analysis, matrix mathematics, modeling assumptions, and study area considerations.

The IO-PAC model largely follows the approach taken for development of the Northeast Region Commercial Fisheries Input-Output Model (NERIOM) by Steinback and Thunberg (2006), however, IO-PAC differs from NERIOM in several significant ways, which will be noted. IO-PAC relies upon the *Impact Analysis for Planning*

(IMPLAN) Professional software and associated state and county data sets for construction of regional IO-SAM models. *IMPLAN* is a widely-accepted system for regional economic impact analysis, licensed by Minnesota Implan Group, Inc (Stillwater, MN), with over 500 licensed users. It is known for its very high level of geographic and industrial detail. Currently, *IMPLAN* offers 440 industry sectors classified according to *North American Industrial Classification System (NAICS)*. Regional data sets are available for all counties and states in the United States, and are updated annually. *IMPLAN* provides regional economic multipliers that capture the direct effects of changes in final demand or employment for any given set of industry sectors, indirect effects of changes in supply chain input purchases, and induced effects of changes in personal income and household spending. In practice, *IMPLAN* gives multiplier values that are comparable to other IO modeling systems, such as the Regional Input-Output Modeling System II (RIMSII) maintained by the U.S. Commerce Department, Bureau of Economic Analysis.

It was agreed that impact analysis should be limited to the fishery harvesting sector(s) and the closely linked sectors for wholesale seafood dealers and seafood processors, but not beyond this in the distribution chain, since there are widely available substitutes and competitive imports for domestically produced seafood products. The IO-PAC model used an accepted technique of setting regional purchase coefficients (RPCs) to zero in order to avoid double-counting of backward-linked effects between seafood harvesters, wholesale dealers and processors, and to enable use of output (revenue) changes as inputs to the model rather than final demand, as is generally the case for input-output models (Steinback, 2004).

The documentation did not state specifically which social accounts were included endogenously within the model, but it was stated in the meeting that household and state/local government accounts were included, and that federal government accounts were not. In this case, it may be appropriate to include federal government, given the level of oversight of seafood industry through on-board observers, and food safety regulations. It may also be appropriate to include the capital account, since there are likely to be large changes in investments levels resulting under various fisheries regulatory or management actions.

The IO-PAC model was extensively modified from the original *IMPLAN* model to incorporate new industry sectors for 19 different types of fishing vessels, and new commodities for 32 species group/gear types mapped to the vessel sectors through the commodity-by- industry (make) table. All commercial fishing vessels operating on the west coast are registered with the Pacific Fisheries Commission, which maintains information on vessel length, weight, horsepower, and annual landing volumes and values for each species. Vessels were classified according to a typology based upon vessel size, principal gear type and species group caught as a share of total landings. The species group/gear type commodity codes represent 12 broad classes of fish species (Whiting, Sablefish, Dover/Thorneyhead, Other Groundfish, Crab, Shrimp, Salmon, highly migratory species, coastal pelagic species, Halibut, Other species, and Bait) in combination with four gear types (trawl, fixed gear, net, other), although not all possible combinations apply. These vessel types, species groups and gear types appear to be well established and to have clearly understood meaning in the fisheries management stakeholder community.

The implementation of new commodity codes for species groups/gear types in IO-PAC is a virtue of the model, allowing simple specification of impacts that affect particular species or gear types. It was felt that this type of impact would be the most common way in which the model is used.

The regional scope of the IO-PAC model includes 18 individual port areas consisting of one or more coastal counties surrounding major commercial fishing port cities, as well as individual states or the entire Pacific states region of Washington, Oregon, and California. The states of Washington and Oregon each have four port areas identified, while California has ten. Thus, the model has flexibility to accommodate different geographic levels of potential impacts. Regional models in IO-PAC are constructed separately for each state or port region using the *IMPLAN* data for that region. This will require the purchase of county-level data packages and occasional updates for each of the three states. *IMPLAN* models should be updated at least every three years with new regional data, to account for changes in economic structure, as well as updated fishery survey information.

Another regional issue concerns the fact that Alaska based vessels commonly operate in west coast waters. In the long run, it may be worthwhile to consider developing a regional economic model for the Pacific coast that include Alaska fisheries together with the west coast of the coterminous U.S., since fisheries management actions may affect fishing vessels and communities in both of these regions.

Industry production functions for the various fishing vessel types were developed from cost-earnings surveys of the limited-entry and open access fishing fleets, together with independent information on moorage fees and state-specific taxes. The quality of survey data will be discussed at length below. Survey data were deemed sufficient to develop unique production functions for eight of the vessel types; however, little or no data was available for 11 other vessel types, which required that a generic weighted average production function be used. It is intended that new information for specific vessel types will be incorporated into the model as it becomes available through future surveys. In general, the production functions appear to be reasonable, and show distinct differences in spending for the various vessel types, presumably relating to vessel size, crew size, operating patterns, and supplies consumed. The assignment of expense categories to IMPLAN sectors, the use of personal consumption expenditure profiles, and margining of retail purchases was handled appropriately in the IO-PAC model.

The most notable shortcoming of the production functions in the model is the absence of information on ownership costs for fishing vessels; such costs are likely a very significant item, representing perhaps 10 to 15 percent of total annual costs (Steinback and Thunberg, 2006; Kirkley et al 2004). The model does include interest expenses for borrowed capital, but does not include principal payments on loans or depreciation. Total capital costs could be reasonably estimated with existing survey data reported on vessel market values, together with expert opinion on average useful life or turnover times.

The production functions also included a cost item “miscellaneous other”, estimated at 5 percent of total costs, intended to represent other minor costs not specifically itemized in the surveys. Perhaps a more defensible approach would have been to request information in the surveys on the sum of all other miscellaneous costs, along with a listing of the items included. See further discussion of data collection below.

Proprietor income, or net earnings to the vessel owner, for each vessel type was estimated as a residual of total revenues (from PACFIN data) less total costs reported. Because the surveys did not account for capital costs, as noted above, the net earnings estimates may be significantly overstated. Proprietor income and employee expenses (captain and crew share) were assigned to the social account for employee compensation. A somewhat more refined treatment of this data in the model would be to apportion these values into payroll taxes and net earnings ("take-home" pay), then assign the payroll taxes to indirect business taxes, and assign the net earnings to one or more of the household income groups. This enables use of a more detailed profile of personal consumption expenditures that reflects the different spending patterns for various income levels. For example, vessel captains may be expected to have a significantly higher average annual income, resulting in greater discretionary purchases of goods and services, as well as higher savings and investment rates, some of which are likely to be a leakage from the region. Expenditure profiles are available in IMPLAN for nine different annual household income groups, from $15,000 or less to over $150,000.

The industry production function for the seafood processor sector was taken from for the default IMPLAN data. Based upon discussions in the meeting, it is apparent that there is a general lack of detailed information on the seafood processing sector, and better information is needed here. The production function for the seafood wholesale dealer sector was taken from Kirkley, Ryan and Duberg (2004), and this is well justified, given that seafood handling likely differs significantly from generic wholesale trade. Wholesale trade was appropriately treated as a margin sector, with the value of the raw fish purchased netted from the estimated revenue change entered into the IO model.

An important aspect of the estimation procedure concerns the assumptions regarding product flows to seafood dealers and processors, and markup margins by these market channels, because these factors have a dominating effect on the overall results. Product flows from the fishery harvesting sector to wholesale seafood dealers and seafood processors were estimated from data on the Washington State "fish food tax", which reports aggregate values for 12 different NAICS industries, including canning and fresh/frozen seafood processing (42%), and seafood merchant wholesalers (30%), as well as various retail outlets. Product flow for taxes paid by the fin fishing sector (12.6%) were assumed to represent direct sales to consumers. These data are likely to be accurate, under the assumption of due diligence in tax collection, but may not be representative for the other states besides Washington. Alternative sources for product flow information should continue to be sought, especially for California and Oregon.

In the IO-PAC model, following from NERIOM, marketing margins for seafood wholesalers were set at 40 percent of sales, which translates to an increase of 167 percent on value at the harvester level. This was based on information reported by the Fulton Fish Market in Boston. However, benchmark data on wholesale distribution industries by U.S. Commerce Department suggest that gross wholesale margins for seafood dealers and other types of perishable food wholesalers are likely in the range of only 16 to 20 percent, rather than 40 percent. Margins for seafood processors in the model were taken from the default IMPLAN data (sector 71, Seafood

Product Preparation and Packaging), estimated at 70 percent, which seems reasonable for a manufacturing sector. The value of fish purchased from harvesters by seafood wholesalers was deducted from the estimated total sales, to reflect the gross margin, which is appropriate to avoid double-counting of commodity values for a wholesale (margin) sector.

Quality and Quantity of Data Used in the Model

Two surveys were conducted of the fishing fleet population to document costs and earnings in order to develop the customized production functions for the new vessel types specified in the regional model. The surveys were conducted as a census of the limited entry fishing fleet population in 2004 (n=264) and the open-access fleet in 2005/06 (n=1152). The survey questionnaires were designed under consultation with the relevant scientific and industry groups (MWFSC, SWFSC, PSMFC, PFMC), and implemented according to generally accepted principles to maximize response rates (e.g. Dillman), with advance notice to survey participants, repeated attempts made to contact, and endorsement by respected stakeholder organizations. Surveys of limited entry vessels were done through personal interviews, while surveys of the generally smaller open access fishery vessels were done by both personal and telephone interviews. Surveys were conducted by subcontractors (Gilmore Research and ORC Macro), who were generally observed to do a good job, according to NWFSC staff. The survey subcontractor employed a recruitment expert to arrange for interviews, and two individual interviewers conducted all interviews, which would be expected to enhance data consistency. Cost data reported by respondents was appraised to be of high quality, generally reported as exact figures taken from financial records rather than rounded values recalled from memory.

Response rates were good for the limited entry fleet survey (63%), including a mix of trawl and fixed gear type vessels, but were only fair for the open-access fleet survey (32%), and were particularly low for telephone interviews of open-access vessels (25%). It is acknowledged that the population of fishing captains and vessel owners is especially difficult to survey. Sampling intensity was much lower for the open-access fleet, with respondents representing only about 15 percent of the population. The survey sampling of open-access vessels was biased toward larger vessels by selecting those for the personal interview survey with at least $25,000 in annual landings. Respondent numbers were unreliably low for some population subgroups in the limited entry fleet, including Washington state trawlers (9), other groundfish fixed gear (8), and other fixed gear (4), and in the open-access fleet, including highly migratory species vessels (3), sablefish (6), pelagic netter (0), and other vessels with annual landings greater than $15,000 (2). It was suggested that response rates might have been increased by offering an incentive payment, which is increasingly common in survey research, to recognize a value for the respondent's time.

Survey data were tested for differences against the non-respondent population with information available from PACFIN for vessel characteristics (length, horsepower) and landings by species group, using two-sample t-tests. Significant differences were found for some groups, including higher overall value of landings for both limited entry trawl and fixed gear respondents, and open-access respondents ($p<0.05$). Although the differences in some

case were substantial, they may not be critical for estimation of the industry production functions, the primary objective of the surveys. In cases where significant differences were detected, results were corrected (weighted) for the response bias in an acceptable fashion. Data for the open-access survey for 2005 were discarded because conditions under the collapsed Salmon fishery that year were deemed unrepresentative.

Information on the location of expenditures made by survey respondents (home port, home state, west coast, Alaska, U.S., outside U.S.) apparently was collected in the survey, but was not reported or even mentioned in the documentation. Was this information incomplete or otherwise deemed to be unreliable? The information could potentially be used to refine the regional purchase coefficients (RPCs) in the model.

Data on average moorage costs within each state were developed from a sampling of marinas, and appear to be consistent with respect to length of vessel. Moorage costs were substantially higher in California. Data on taxes are quite complicated, with different tax rates applied to different species; taxes are applied on a per pound basis in California, but are assessed as a percentage of value for Washington and Oregon state taxes, and Federal taxes. It was assumed that the first buyer of raw fish pays the tax, except in cases where product is sold directly to consumers, consistent with the tax code.

Changes in revenues for specific vessel types or species/gear commodity types were estimated from landings data available from the Pacific Fisheries Information Network (PACFIN fish ticket data), which is very reliable because it is legally required to be reported for any vessel with at least $1,000 in annual landings. The classification of vessel types available from the Pacific States Marine Fisheries Commission is well known but appears to not be very robust.

Evaluation of Model Assumptions, Estimates and Sources of Bias or Uncertainty

The IO-PAC model, like all input-output models, is based upon several important assumptions, including fixed technologies, fixed prices, and no capacity constraints. These assumptions are well-recognized in the regional economics profession, and while non-trivial, are generally acceptable for applications in which impacts occur over a relatively short time period, or represent a marginal change in overall regional economic activity. The assumption of fixed prices means that prices of both inputs purchased and products sold remain constant, and does not allow for price changes or substitution effects in response to market supply/demand conditions. In general, this may lead to an overestimation of economic impacts resulting from a specified change in output or final demand. IO models assume that the types of inputs purchased by an industry are in a given fixed proportion, based upon relationships prevailing at the national level. In this case, the IO-PAC model overcomes this limitation by incorporating regional information for development of the customized fishery harvesting sectors. Extension of the IO-PAC model to a Computable General Equilibrium (CGE) framework, would overcome the assumption of fixed prices and capacity constraints, but probably at some loss of industrial detail because the number of sectors has to be minimized to keep the model manageable.

Statement on Whether the IO-PAC Model Represents Best Available Science

In general, there was broad agreement among the two independent reviewers that the proposed IO-PAC model for regional economic impact assessment of Pacific fisheries was well designed and will provide valid and defensible estimates of economic impacts resulting from changes in fishery harvest levels. It was concluded that the approach followed represents the state of the art and best professional practice in regional economic impact analysis.

Statement on IO-PAC Model Treatment of Different Fisheries

The IO-PAC model and supporting data are strongest for analysis of impacts due to changes in groundfish harvests, which is the species group of greatest concern currently for fisheries management in the Pacific region. However, the model has been appropriately designed as a flexible framework to incorporate additional information for other fish species groups, vessel types, and gear types, as it becomes available through further surveys.

Recommendations for Further Improvement of the Model

Following are a series of specific recommendations for revisions and further development of the IO-PAC model:

- Personal income received by boat captains and crew should be assigned to an appropriate household income group in *IMPLAN*, to more accurately reflect consumption expenditures. This will require that payroll taxes and other deductions (e.g. health insurance) be deducted first, to give net take-home pay.
- Information on capital costs of vessel ownership, including principal and interest payments, and depreciation, should be incorporated into the production functions for vessel types in the fishery harvesting sectors. Capital costs could be estimated from existing data on market value of vessels, together with expert information on average useful lifetimes or turnover rates for these assets.
- Information on other vessel types not currently available should be incorporated into the model as additional survey information becomes available.
- The markup margin for wholesale seafood dealers should be set at 15 to 20 percent, rather than 40 percent, consistent with benchmark data on wholesale distribution industries by Economic Census (U.S. Commerce Department).
- Additional data on product flows from the harvesting sector to wholesale seafood dealers and seafood processors should be sought, especially for Oregon and California. This may be possible from analysis of PACFIN fish ticket data.
- The model should be updated at least every three years with new IMPLAN data to reflect changes in the regional economy, as well as new information from fishing fleet surveys.

- As time and staff resources allow, recreational fisheries should be incorporated into the model, to account for this increasingly important sector.
- Consider including Alaska fisheries together with Washington, Oregon and California, in a broader regional model, since many large vessels operate in both regions.
- As practicable, the model may be extended to a Computable General Equilibrium (CGE) framework, based on regional *IMPLAN* SAM data, to account for changes in market prices and capacity constraints, in order to overcome some of the recognized limitations of IO models.

Evaluation of the Panel Review Process

At the panel review meeting (Oct. 6, 2009) held at NWFSC in Seattle, presentations were made by NWFSC staff on general Pacific fisheries science issues (Hastie), model motivation and uses (Lee), data used in the model by two separate surveys (Lian), production functions and output functions, model structure, and impact estimation examples (Leonard). Copies of presentations were provided.

It was agreed among the formal reviewers in advance to keep the meeting informal and collegial in nature, to allow questions and discussion at any time. In fact, there were numerous questions raised, and considerable discussion generated throughout the meeting in relation to all aspects of the review process. In this reviewer's opinion, the meeting was generally effective in achieving a critical independent review of the technical merit of the methodology for the IO-PAC model.

One issue in particular which generated considerable discussion concerned the formulation of separate regional models for each port area and state. This differs from the approach taken in the Northeast Region Fisheries Model (NERIOM), which consists of a single model, with direct impacts specified for sub-regions and gear types, while indirect/induced impacts within sub-regions are estimated using a location quotient procedure outside of IMPLAN. It was agreed that the method followed by IO-PAC was technically superior in treating each region as an independent model, thereby capturing the appropriate region-specific endogenous linkages and trade balances. However, there were questions raised about the staff time and effort required to run the IO-PAC modeling system for impacts that may affect a number of individual port areas, which will require that models be developed and modified and executed separately for each of the port areas affected (up to 18x). Implementation of the new industry and commodity types into an *IMPLAN* model is accomplished through changes to 14 underlying tables in the *Microsoft Access* database of the *IMPLAN* social accounts—not a trivial task, but one that can be accomplished by an experienced *Access* user. The model developers (Leonard and Watson) insisted that completely new models can be developed expediently, certainly within a day. The much-anticipated version 3 of the *IMPLAN* software, to be released this year, will offer a multiregional modeling capability, which may allow more efficient handling of such impact analyses.

Another issue discussed at length concerned the classification of 19 different vessel types available from the Pacific States Marine Fisheries Commission that was used for development of customized production functions in

the IO-PAC model. There was a consensus that these vessel types do not represent a rigorous, mutually exclusive classification system, and it may not capture the seasonal, multi-fishery activity of many non-specialist vessels. However, in absence of any better information, this typology is the best available currently. Perhaps a more rigorous classification of vessels could be accomplished by cluster analysis of the PACFIN landings data, to identify a somewhat smaller but mutually exclusive set of vessel types that reflect common patterns of fishing activity.

Editorial Comments on Model and Survey Documentation

Following are some specific corrections recommended to make the documentation of the regional model and supporting surveys more clear and readable.

Description of the IO-PAC Model

- Formula given for calculating revenue change of wholesale seafood dealers should include the product flow share (30%) in the second term, to deduct value of purchases from harvest sector, since this is being treated as a margin sector (page 32).
- Total revenues for each vessel type and commodity/gear type given in Table 8 could be abbreviated or presented more compactly, in order to see relationships in the data.
- Results given, for example impact analysis, should be revised as given in presentation.
- Counties included in each port region should be shown in table in Appendix A.

Survey of Limited Entry Fleet

- Tables 2 and 3 comparing results for survey respondents and non-respondents should give standard error rather than standard deviation, so that variability can be compared directly to the mean values.
- In these same tables, the test statistics that represent a significant difference ($P<0.05$) should be noted explicitly with an asterisk.
- It would be helpful to show a total of expense items for each vessel type in Table 4.
- The procedure for calculation of weighted averages for survey data that were adjusted should be given in this document, as well as in the model documentation.
- Figures 1 and 2 showing distribution of net annual earnings could be simplified to show the percentage of respondents within groups such as less than zero, 0 to $49k, $50-100k, over $100k.
- Question numbering and directions for jumps to other questions are incorrect in the survey questionnaire in Appendix A.

Survey of Open-Access Fleet

- Many of same comments for the limited entry survey document apply here.

- The document in some places refers to the limited entry trawl fleet rather than the open-access fleet (p. 9, 11).
- Results for average revenues given in the text (p. 10) do not match with tables 3 and 5.
- Reference to data on average revenues on page 11 should be Table 6 rather than Table 8.

Literature Cited

Dillman, D.A., 2007. *Mail and internet surveys: The tailored design method* (2nd ed.). John Wiley & Sons Inc., Hoboken, NJ.

Kirkley, J.E, W. Ryan and J. Duberg, 2004. *Assessing the economic importance of commercial fisheries in the Mid-Atlantic region: A user's guide to the Mid-Atlantic input/output model*, Virginia Institute of Marine Science, National Oceanic and Atmospheric Administration Cooperative Marine Education and Research Award.

Leontief, W., 1953. *Studies in the Structure of the American Economy*. Oxford University Press, New York.

Miller, R.E. and P.D. Blair, 1985. *Input-output Analysis: Foundations and Extensions*. Prentice-Hall, London

Steinback, S.R., 2004. Using ready-made regional input-output models to estimate backward linkage effects of exogenous output shocks. *The Review of Regional Studies* 34(1):57-71.

Appendix 1: Bibliography of Documents Provided For Review

- Description of the Input-Output Model for Pacific Coast Fisheries (IO-PAC); draft document for CIE Review (version II). Jerry Leonard and Phil Watson, NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington, 79 pages September, 2009.
- West Coast Limited Entry Cost Earnings Survey Protocol and Results for 2004; draft document for CIE Review (version II); Carl E. Lian, NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington, 26 pages, September 2009.
- West Coast Open Access Groundfish and Salmon Troller Survey Protocol and Results for 2005; draft document for CIE Review (version II); Carl E. Lian, NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington, 22 pages, September 2009.
- Northeast Region Commercial Fishing Input-Output Model, NOAA Technical Memorandum NMFS-NE-188; Scott R. Steinback and Eric M. Thunberg, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA, 56 pages, April 2006.

Appendix 2: Panel Membership for the Review Meeting

- Scott R. Steinback, PhD, Fisheries Economist, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA (independent reviewer)
- Alan W. Hodges, PhD, Extension Scientist, University of Florida, Food & Resource Economics Department, Gainesville, FL (independent reviewer)
- Todd Lee, NOAA-NMFS-Northwest Fisheries Science Center
- James Hastie, NOAA-NMFS- Northwest Fisheries Science Center
- Carl Lian, NOAA-NMFS- Northwest Fisheries Science Center
- Jerry Leonard, Economist, NOAA-NMFS- Northwest Fisheries Science Center
- Leif Anderson, NOAA-NMFS- Northwest Fisheries Science Center
- Mark Plummer, NOAA-NMFS- Northwest Fisheries Science Center
- Steve Freese, NOAA-NMFS, Northwest Regional Office
- Chang Seung, NOAA-NMFS-Alaska Fisheries Science Center
- Phil Watson, Assistant Professor, University of Idaho, Moscow, ID
- Dave Colpo, Pacific States Marine Fisheries Commission
- Ed Waters, Pacific Fisheries Management Council

Appendix 3: Statement of Work for Dr. Alan Hodges

External Independent Peer Review by the Center for Independent Experts

Review of Methods Used to Produce the West Coast Region Fishery Input-Output Model

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.com.

Project Description:

The Northwest Fisheries Science Center's West Coast Region Fishery Input-Output Model (WECRIOM) is designed to estimate the gross changes in economic contributions and net economic impacts of policy changes that affect fishery harvest in California, Oregon, and Washington. WECRIOM is fundamentally a fisheries specific input-output model where unique harvesting sectors that produce unique species and gear outputs are incorporated into a customized IMPLAN regional input-output model. The data used to customize the IMPLAN model were derived from two primary sources: PacFIN fish ticket data maintained by the Pacific States Marine Fisheries Commission (PSMFC) and Northwest Fisheries Science Center's Cost Earnings Survey of the West Coast limited entry trawl, limited entry fixed gear and open access fleet.

The long-run goal in developing WECRIOM is to capture the regional economic impacts of groundfish and other fisheries off the Pacific Coast, including both commercial and recreational fisheries. Due to data availability constraints, the current model best captures commercial groundfish activities. As data for other fisheries become available, the model will be augmented to include more detailed information on those fisheries. Thus the model and data under review is the groundfish portion of the model, as well as the general modeling structure upon which other fisheries will eventually be added.

The Terms of Reference (ToRs) for the CIE review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: One CIE reviewer shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. The CIE reviewer shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. The CIE reviewer shall have expertise and work experience in input-output models, IMPLAN software, and a general understanding of the commercial fishing industry. Knowledge of creating or modifying industrial sectors in IMPLAN is desirable.

Location of Peer Review: The CIE reviewer shall conduct an independent peer review during a 1-day panel review meeting tentatively scheduled in Seattle, WA on October 6, 2009.

Statement of Tasks: The CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and information concerning other

pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., name, contact information, birth date, passport number, travel dates, and country of origin) to the NMFS Project Clearance for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations (available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site to the CIE reviewer all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewers shall read all documents in preparation for the peer review.

Documents to be provided to the CIE reviewers prior to the review panel meeting include:

- WECRIOM summary and documentation;
- The draft Cost Earning Survey Data Summary;
- Northeast Regions Commercial Fishing Input-Output Model, NOAA Technical Memorandum NMFS-NE-188

The NMFS Project Contact will provide the complete list of background documents with estimated page numbers no later than 1 August 2009.

Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: The CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

The review panel will consist of one CIE reviewer and two outside reviewers selected by the Northwest Fisheries Science Center (NWFSC).

The CIE reviewer's role includes being an active panel participant and participants are strongly encouraged to voice all comments regarding the data used in the model, and model configurations so that these comments may be discussed or addressed during the Panel meeting and incorporate changes in the model or data when appropriate.

Contract Deliverables - Independent CIE Peer Review Reports: The CIE reviewer shall complete an independent peer review report in accordance with the SoW. The CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. The CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: There will be no consensus report and each reviewer should write an individual review report. Of particular concern will be providing advice concerning the comments on data quality, comments on methodology, and recommendations for improvements to each.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting in Seattle, WA, Oct 6, 2009 as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than October 22, 2009, the CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to David Die at ddie@rsmas.miami.edu. The CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

31 August, 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
22 September, 2009	NMFS Project Contact sends the CIE Reviewers the pre-review documents
6 October, 2009	The reviewer participates and conducts an independent peer review during the one day panel review meeting
22 October, 2009	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
5 November, 2009	CIE submits CIE independent peer review reports to the COTR
12 November, 2009	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review report by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, the report shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) the CIE report shall have the format and content in accordance with Annex 1, (2) the CIE report shall address each ToR as specified in Annex 2, (3) the CIE report shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
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Appendix 3-Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   d. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting. The CIE independent report shall be an independent peer review of each ToRs.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review

   Appendix 2: A copy of the CIE Statement of Work

   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Appendix 3-Annex 2: Terms of Reference for the Peer Review

Review Panel for Assessments of West Coast Regional Input-Output Model

- Evaluate and comment on the impact modeling approach and methodology.
- Comment on the overall quantity and quality of data used in the model.
- Evaluate model assumptions, estimates, and major sources of bias or uncertainty. Specifically, recommend improvements including alternative model configurations or formulations, or data sources or uses as appropriate.
- Insert an explicit statement as to whether this input-output model represents the best available science for estimating regional economic effects from changes in commercial groundfish catch off the Pacific coast.
- Insert an explicit statement as to whether this input-output model represents a viable modeling framework upon which other fisheries (in addition to the commercial groundfish fishery) can be added in the future as data on other fisheries become available.
- Recommendations for any further improvements given data limitations.
- Brief description of panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Appendix 3-Annex 3: Tentative Agenda

Review Panel for Assessments of West Coast Regional Input-Output Model

Northwest Fisheries Science Center, 2725 Montlake Blvd. E, Seattle WA 98112

October 6, 2009

Point of contact for reviewer security & check-in: Dr. Todd Lee

8:00	Introduction
9:00	Data used in the model
11:00	Production functions and output functions
12:00	BREAK
1:00	Model structure
2:30	Impact estimation examples
4:00	Other issues and general discussion
5:00	Adjourn